Success and failure in the political economy of solar electrification: lessons from World Bank Solar Home System (SHS) projects in Sri Lanka and Indonesia

Article (Accepted Version)

Success and failure in the political economy of solar electrification: Lessons from World Bank Solar Home System (SHS) projects in Sri Lanka and Indonesia

Benjamin K. Sovacool*[12]

[*] Corresponding Author, Science Policy Research Unit (SPRU), University of Sussex
Jubilee Building, Room 367, Falmer, East Sussex, BN1 9SL
Phone: +44 1273 877128 Email: B.Sovacool@sussex.ac.uk

[1] Science Policy Research Unit (SPRU), School of Business, Management, and Economics, University of Sussex, United Kingdom

[2] Center for Energy Technologies, Department of Business Development and Technology, Aarhus University, Denmark

Abstract: This study contrasts two national solar home system (SHS) programs that relied on the same World Bank approach, but reached dramatically different results. The Energy Services Delivery Project (ESDP) in Sri Lanka was an exemplary renewable energy access program, successfully installing 21,000 off-grid SHSs alongside grid-connected mini-hydro capacity and off-grid village hydroelectric systems. It reached all of its targets ahead of schedule and below cost. By contrast, the Indonesia Solar Home System Project (ISHSP), which ran from 1997 to 2003, sought to reach one million rural Indonesians through the sales and installation of 200,000 SHSs. However, by project closing in 2003, less than five percent of the original sales target, or only 8,054 units, had been installed. The ESDP and ISHSP were the World Bank's first foray into a "market-based renewable energy services provision model." Based on original research interviews and field observation, the article finds that contrasting the two programs—one a success, the other a failure—offers lessons for energy and development practitioners, namely that effective programs are those that select appropriate technology, often with input from households themselves; they promote community participation and ownership; and they have robust marketing, demonstration, and promotion activities.

Keywords: rural energy use; energy poverty; energy security; solar photovoltaic (PV) panels; solar home system; electrification

1. Introduction

Lack of access to electricity and dependence on traditional fuels for cooking and heating remains an enduring economic development issue for many countries, one that has catalyzed significant international momentum towards universal energy access via initiatives such as Sustainable Energy for All and the Sustainable Development Goal 7 (Ockwell and Byrne 2017; International Energy Agency 2017; Gollwitzer et al. 2018). The International Energy Agency (2018) estimates that worldwide about $13 billion in capital is invested at improving access to electricity or cooking devices annually.

To meet these targets, channel this investment, and capture some of the plentiful co-benefits of energy access (such as reductions in poverty, gender empowerment, improved health, and skills development, to name a few), a variety of programs and business models have blossomed over the past decades (Chaurey et al. 2012; Sovacool 2013a; Halff et al. 2014). As merely a glimpse of the depth and complexity of actions, between 2011 and 2015, more than 106 countries have actively and formally engaged with Sustainable Energy for All and provided financial or in-kind contributions or working on tailored national strategies and investment plans (Sustainable Energy for All 2016). One of the most significant technologies for expanding access to modern energy services within these approaches is solar electrification, especially via solar home systems, or SHSs (Ulsrud et al. 2015; Ulsrud et al. 2018 Ockwell et al. 2018; Venkateswaran et al. 2018).

Despite the abundance of actors promoting solar (and other) energy options, however, one of the most influential remains the World Bank. The World Bank Group (WBG) is a major source of financing for energy and infrastructure projects including pipelines, oil and gas fields, and power plants as well as off-grid energy systems such as solar home systems and micro-hydro dams. The World Bank in particular is a multilateral institution that provides loans and credit to developing countries to stimulate social and economic development in an attempt to alleviate poverty (Clark 1999; Sovacool 2017).

This comparative study contrasts two World Bank funded national SHS programs—one in Sri Lanka, and one in Indonesia—that relied on the same approach but reached dramatically different results. The Energy Services Delivery Project (ESDP) in Sri Lanka cost-effectively installed 21,000 off-grid SHSs and a series of village hydroelectric systems ahead of schedule and below cost.[1] By contrast, the Indonesian Solar Home System Project (ISHSP) reached less than five percent of its target, or only 8,054 units. The ESDP and ISHSP were the World Bank's first foray into what has now become known as a "market-based renewable energy services provision model." Based on original interviews and field research in both countries, this study explores the dynamics of both programs as well as implications for energy access policy more generally.

In contrasting the ESDP with the ISHSP, the article aims to make three contributions. First, and critically, it analyzes a case of success, commonly referred to as "best practice," alongside a case of failure, or "worst practice." We took a rather simple notion of failure to mean a "successful" project met its goals or produced benefits that exceeded costs; a "failed" project did not meet its goals or had costs that outweighed benefits. In doing so, the study identifies not only the programmatic factors that often result in the success or failure of individual case studies, but also the extent that the complex agendas of international and bilateral energy and development agencies, manufacturers, research planners, politicians, and community

---

[1] Admittedly, some of the program's successes have since been obviated by massive investments in grid electrification. AS these occurred after the project's close, they are outside the scope of this study, although they are discussed in Sovacool and Drupady 2012 and Sovacool 2013b.

leaders harmonize, or hinder, programmatic efforts. Both the energy policy community and perhaps the development community as a whole need to better understand the dynamics of failure alongside the better-known reasons for success.

Second, this study delves into how both Sri Lankan and Indonesian planners attempted to supply energy services in moments of crisis. Sri Lanka was undertaking the ESDP as they dismantled the functions of the welfare state, promoted privatization and restructuring, and emerged from a 26-year old civil war—providing insight for how such tensions can be managed (Caron 2002). Indonesia was similarly dealing with the Asian Financial Crisis as its national program was unfolding (Sovacool and Drupady 2012).

Third, the study illuminates how the World Bank designs and implements their energy projects. The WBG's annual average lending ranges $60 to $70 billion in loans, grants, equity investments, and loan guarantees (World Bank 2015), making it the largest international development bank in the world. Though it operates independently, the WBG's major shareholders are France, Germany, Japan, the United States, and the United Kingdom, and its major borrowers are Brazil, China, India, Indonesia, Mexico, and Russia. Understanding the internal dynamics, processes, and accountability mechanisms of the WBG is therefore of importance for both scholars of environmental governance and energy policy and practitioners of multilateral financial aid. Keohane (2002) describes institutions such as the WBG as "organized anarchies" created to reduce transaction costs, facilitate information, and empower agents to orchestrate complicated actions. This study therefore underscores the differing contextual factors that can hamper or stymie WBG efforts (and perhaps those facing other, similar multilateral financial institutions).

2. Case study selection and background:

This section briefly justifies Sri Lanka and Indonesia as case studies before summarizing the specific dynamics of each of their national SHS programs.

2.1 Sri Lanka's Energy Services Delivery Project (ESDP)

At the turn of the millennium, Sri Lanka faced a series of daunting energy security and development challenges. It was primarily a biomass centered energy sector, with 47.4 percent of demand met from fuelwood and dung, 43 percent petroleum, and 9.5 percent hydropower (Sri Lanka Sustainable Energy Authority 2009). Seventy percent of households depended on biomass, mostly for cooking, and electricity represented only 7 percent of overall energy use. Moreover, 60 percent of household demand for electricity went to one use only, lighting (Nagendran 2001). About half of the population earned less than $2 per day (Integrated Development Association 2004).

To minimize the health implications of households biomass use, diversify the energy sector, and improve incomes for communities, the WBG and Global Environment Facility (GEF) initiated the $55.3 million ESDP Project in 1997. The ESDP aggressively promoted SHSs alongside various community based micro-hydro projects, a wind energy pilot, and energy efficiency investments. Its key objectives were to provide electricity to rural households, strengthen the regulatory environment in favor of energy efficiency, improve private sector performance, and reduce carbon emissions (Sovacool 2013b).

The Credit Line Component was the largest part of the ESDP, and the one most relevant to it solar targets. It provided medium and long-term financing, targeting rural households themselves, contrasted with other ESDP components such as micro-hydro, targeted for village cooperatives, tea estate management companies, and independent power producers. One defining characteristic of the Credit Line was its phased-reduction of grants. Rather than cover costs entirely, the component gave a series of grants on a sliding scale. At the start of the program, all SHS received a 15 to 20 percent subsidy. The GEF, a partner, also gave performance-based grants if costs declined or efficiency improved. SHS dealers received a $2.30 subsidy per Watt-peak (Wp) for offering smaller sized systems over time. However, these grants were slowly phased out so that by 2002 they covered only 8 to 12 percent for SHS, and by 2004 they did not exist at all. Vendors generally responded either by improving the efficiency of their operations to keep costs low, or by reducing their inventory. In 2002, the Credit Line Component was also modified to include microfinance institutions and Sarvodaya Economic Enterprises Development Services (SEEDS) agreed to manage the program. SHS penetration quickly grew, jumping to more than 3,200 SHS sold in 2000 (Nagendran and Iyer 2001) and eventual system sales of 1,300 per *month* (Kapadia 2003).

A capacity-building component supported a wide array of capacity building activities. One of the first tasks to be undertaken was an extensive feasibility study of 1,048 villages to determine possible sites for SHS deployment. It was this collection of initial market surveys and pre-investment studies where planners discovered that end users were willing to pay slightly more upfront if energy services were more reliable and safer—e.g., SHS were perceived more favorably than kerosene and diesel. The ESDP established a Technical Advisory Committee to set standards for manufacturers. It provided funds for the Ceylon Electricity Board (CEB) to prepare a National Renewable Energy Strategy and establish a Pre-Electrification Unit within the utility to provide support and training to the Credit Component discussed above. Funds were also available to participating credit institutions (PCIs) to prepare feasibility studies, business plans, and document bank loans, and grants were given to developers and village organizations to raise awareness about the ESDP and promote the proper installation of equipment.

The ESDP was an unqualified success. It achieved all of its targets below cost and ahead of its determined closing date of 2002, successfully installing 21,000 off-grid SHS along with more than 31 MW of micro-hydro power at grid-connected and village scales, and a 3 MW grid-connected wind farm. By the end of 2004, two years after the ESDP's close, the Sri Lankan renewable energy industry had more than 40 mini-hydro developers, 10 registered solar companies, 22 registered village hydro developers, and 12 village hydro equipment suppliers compared to less than 3 of each before the ESDP began. Roughly three times the ESDP's budget, $150 million, was invested in the market from 1998 to 2004 (Sovacool 2013b). Furthermore, the ESDP attracted private sector developers into the renewable energy sector through public-private partnerships, set national grid interconnection and tariff standards, and instigated the formation of hydro, wind, solar, and energy efficiency industry groups.

2.2 Indonesia's Solar Home System Project (ISHSP)

Indonesia is a vast, sprawling archipelago of more than 13,600 islands covering an area of roughly two million square kilometers or a little less than three times the size of Texas (the second largest state in the United States). Known as the "spice islands" throughout much of its history, it is the largest country in Southeast Asia both in terms of population and size, and it is blessed with an abundance of natural resources. In 1995, the country was still riding a wave of high economic growth resulting from the dramatic increase in oil export revenues in the 1970s (World Bank 2011). Moreover, the abundant oil and gas sectors were supplying over 85 percent of the country's commercial net energy consumption (World Bank 1996).

However, a gross domestic product (GDP) per capita of $1,014 placed Indonesia sixth out of 10 countries in Southeast Asia. Approximately 17.6 percent of its 199 million people (roughly 35 million of them) lived below the national poverty line (World Bank 2011) and more alarmingly, 60 percent of all Indonesians still had no access to basic electricity services (World Bank 1996). With 70 percent of the population still living in rural areas, expanding rural electrification was integral to the government's economic development strategy. Rural electrification coverage in Indonesia was still at 40 percent – well below the regional average (World Bank 1996). In 1995, however, a local entrepreneur in West Java managed to sell 4,000 SHS units on credit in the first year of operation (Miller and Hope 2000). Seemingly, technological innovations coupled with the availability of compatible and energy-efficient devices had made the SHS market more competitive. Thus, in the absence of grid connection, the lesson appeared to be that rural households were willing to pay market prices for a reliable alternative (Sovacool and Drupady 2012), and a window of opportunity was emerging.

These market trends convinced planners to embark on "something big" to simultaneously validate the World Bank's energy strategy and meet Indonesian rural energy targets. The Indonesia SHS Project set an ambitious target of selling and installing 200,000 SHS (10 MWp) to supply electricity to approximately one million rural villagers. The Indonesia SHS Project ran from 1997 to 2003 and was valued at $118.1 million equivalent, with seed money of $44.3 million equivalent or 38 percent of the project costs to be provided by the WBG and the GEF (World Bank 2004). It was to be a massive undertaking, requiring serious investments to be made into both developing Indonesia's solar photovoltaic (PV) market and formulating a national energy access policy to incentivize the adoption of renewable energy technologies.

However, rather than relying on government funding, the bulk of the project's costs of $67.3 million was to be financed mainly on credit from sub-borrowers (SHS dealers) and end-users (rural customers) as summarized in Table 1. The idea was to target only those villagers willing and able to pay for electricity services in order to nurture and develop a self-sustaining solar PV sector.

Table 1: Sharing of Project Costs in the Indonesian Solar Home System Project

Stakeholder	Project Cost $	% of Total
World Bank	20	17
GEF Grant	24.3	21
Government of Indonesia	1.5	1
Participating Banks	5	4
Sub-borrowers/End-users	67.3	57
TOTAL	118.1	100

The main part of the project was the credit component which sought to extend electricity services to about one million people through the sale and installation of 200,000, 50 Wp SHS units to rural households and small commercial establishments like the one depicted in Figure 1. A $20 million equivalent International Bank for Reconstruction and Development (IBRD) loan channeled through four commercial participating banks (PBs) provided a credit facility to address the high cost of SHS units and the financial constraints of dealers and potential customers.

Figure 1: A Small Commercial Establishment Powered by Lights from an SHS, Indonesia

Rural areas that could not expect grid connection from PLN in the next three years or more were identified in the provinces of West Java, Lampung, and South Sulawesi as potential regional markets, with the intent of including North Sumatera at a later stage. All these provinces had rural communities with strong purchasing power due to cash crops such as coffee, cacao, and palm oil (World Bank 2004). West Java was additionally selected due to the initial success of the local entrepreneur mentioned above and also because of proximity to the capital, Jakarta. A population of 38 million easily made it the most populous province in Indonesia at the time, with 19 million people still waiting for electricity and other critical infrastructure (Retnanestri 2007).

A project-approved 50 Wp SHS unit with the necessary components, the only one eligible under the program, cost between $550 and $800 at that time, depending on the sales location (World Bank 2004). Dealers would typically offer credit to prospective customers based on a first cost buy-down in the range of $75 to $100, funded by a separate GEF grant mentioned below. This would bring down the unit cost balance to a level that could be paid in monthly installments over a period of four to five years, in amounts roughly comparable to conventional monthly energy expenditures for kerosene. Customers would in turn be responsible for servicing their own systems, although dealers could provide service contracts or guarantees for a limited period.

The World Bank estimated that credit installments and the interest generated would provide approximately $66.8 million equivalent of the project costs. In addition, a GEF grant of $20 million equivalent, translating into a first-cost subsidy ranging from $75 to $125 for every SHS unit sold, would be awarded to each dealer upon extending credit to customers. This benefit could either be passed on to customers to make the SHS units even more affordable or be used to further develop the business (for example to recruit new staff, establish new rural outlets, or expand product inventory).

Despite the promising signs from West Java, the size of the project's budget, and its distribution of risks via a market based approach, the ISHSP was essentially a failure. During its years of operation from 1997 to 2003, it installed only slightly more than 8,000 units, had negligible effects on solar manufacturing, and limited impacts to Indonesia's rural energy balance.

3. Research Methods: Interviews, Field Research, and Focus Groups

Primary data for this article comes predominately from research interviews and field research as part of research project on energy security in Asia (see Sovacool and Drupady 2012; Sovacool 2013b as well as acknowledgments), in addition to project documents and a sampling of the academic literature. A semi-structured research interview format enabled the research team to ask experts involved with the ESDP and ISHSP a set of standard inquiries but then allowed the conversation to build and deviate to explore new directions and areas. The team relied on qualitative methods because many of the variables of interest, such as the ongoing energy policy challenges facing Sri Lanka or Indonesia and the factors explaining the success of the ESDP and ISHSP, were difficult to measure, and cannot be described purely with numerical analysis.

The research team conducted 92 interviews at 50 institutions. For every interview the author had simultaneous real-time translation into Sinhalese, Tamil, and Bahasa when necessary. A purposive sampling strategy was employed, meaning experts with extensive knowledge of the ESDP or ISHSP were chosen to participate, and a critical stakeholder analysis framework was utilize to include respondents from government, civil society, business, academia, and local communities. Respondents therefore came from:

- *Government agencies* including the Agency for the Development and Implementation of Technology (BPPT), the Ministry of Energy and Mineral Resources (MEMR), and the Ministry of Research and Technology (MENRISTEK) in Indonesia, as well as the Sri Lanka Sustainable Energy Authority, Ministry of Finance, and Ministry of Power and Energy;
- *The international donor community* including the Asian Development Bank, the Japan International Cooperation Agency, the International Finance Corporation, and the World Bank;
- *Civil society organizations* including the Indonesian Renewable Energy Society, Transparency International, Yayasan Bina Usaha Lingkungan, and Yayasan Pelangi

Indonesia, as well as the Institute for Participatory Interaction in Development, Energy Forum of Sri Lanka, and Solar Energy Association of Sri Lanka;

- *Private sector companies* including PT. Gerbang Multindo Nusantara, PT. Mambruk Indonesia, and PT. Trimbasolar in Indonesia, and Hashakee Power (Pvt) Ltd, Alpha Solar Energy Systems (Pvt) Limited, and Vallibel Power in Sri Lanka;
- *Financial Institutions* including CIMB Niaga Bank and Bank Rakyat Indonesia (BRI) in Indonesia, and the Development Finance Corporation of Ceylon (DFCC) Bank and Lankia Orix Leasing Company (LOLC) in Sri Lanka;
- *Local universities, research institutions and think tanks* including the Indonesian Institute for Energy Economics, the Indonesian Institute of Sciences (LIPI), and the University of Moratuwa in Sri Lanka.

In Sri Lanka, these interviews took place not only in Colombo, the capital, but also Battaramulla, Dagama, Hambantota , Meddawatte, Moratuwa, Watawala, and Yatiyanthota, as well as the World Bank headquarters in Washington, DC, United States. In Indonesia, interviews took place not only in Jakarta but also Jangari Village (West Java), Lake Cirata (West Java), and Serdang Village (Lampung).

During these research interviews, participants were asked (a) identify the benefits of the ESDP and ISHSP, (b) summarize some of the key barriers to implementation it had to confront, and (c) discuss general lessons that it offers energy policy and development practitioners. Due to Institutional Review Board guidelines and grant requirements, as well as the request of some participants, such data is presented as anonymous in the study, though information from the interviews was often digitally recorded and always carefully coded.

To ensure a degree of triangulation and reliability, research interviews were augmented with direct observation and site visits to four solar energy facilities shown in Table 2. These included a mix of different provinces and technologies. The site visits allowed the research team to discuss the implications of the ESDP and ISHSP with actual renewable energy operators, managers, and manufacturers. They also served as a useful vehicle to arrange additional research interviews.

Table 2: Solar Energy Site Visits in Sri Lanka and Indonesia

Name	Capacity	Cost (Rs)	Owner/Operator	Date Operational	Location	Connection	Directly Supported by ESDP or ISHSP
Indigolla Village	3.2 kW on 80 Homes	2,880,000	Individual Households	1998	Indigolla, North Western Province, Sri Lanka	Off-Grid	Yes
Dagama Village	2.0 kW on 50 Homes	2,000,000	Individual Households	1999	Dagama, North Western Province, Sri Lanka	Off-Grid	Yes
Ponnilawa Village	1.8 kW on 50 Homes	1,980,000	Individual Households	1998	Ponnilawa, North Western Province, Sri Lanka	Off-Grid	Yes
Trimba Solar Demonstration Facility	-	-	Manufacturer of solar modules, street lamps, batteries		PT. Trimbasolar	-	Jakarta, Indonesia

The research team lastly supplemented interviews, site visits, and community consultations with an extensive review of reports and peer-reviewed articles relating to energy policy in both countries.

4. The political economy of solar success: Sri Lanka

As this section of the paper argues, that the ESDP was a success is practically incontrovertible (Sovacool 2013b). It exceeded every one of its targets, ahead of schedule, and below cost, achievements summarized in Table 3. It connected 16 micro-hydro plants to the national grid, served 22,685 off-grid households, built the wind farm, and met all of its energy efficiency goals (World Bank 2003; United Nations Development Program 2012). Project documents estimated savings of 140,000 tons of carbon dioxide equivalent at an incremental cost of $52 per ton; in actuality, 514,000 tons were displaced at a cost below $19 per ton.

Table 3: Achievements of the ESDP in Sri Lanka

Component	Progress at Project Closing
ESDP Credit Line	Installed 31 MW of micro-hydro serving the grid (16 projects) and 0.94 MW of solar plus 574 kW of village hydro (35 projects) serving 22,685 off-grid customers in aggregate CEB signed 14 SPPAs by mid-term review and 37 by project close Small Purchase Power Agreement Contracts and Tariffs published and updated by CEB since 2000 Interconnection standards published in December 2000
Wind Farm	3 MW wind farm commissioned in March 1999
Capacity Building	Saved 82 GWh per year of energy and displaced the need to build 32.5 MW of electricity capacity Commercial energy efficiency building codes issued in April 2001 Trained 748 CEB and energy professionals through 26 programs on energy efficiency Created an electric appliance labelling program. On-premises load metering of 15 major customers completed Various training and awareness campaigns implemented

Note: MW=megawatt. kW=kilowatt. CEB=Ceylon Electricity Board. SPPAs=small power purchase agreements. GWh=Gigawatt-hour.

Given the focus of this comparative study, the remainder of this subsection will focus exclusively on the solar home system component. At the close of the project, Sri Lanka was home to a vibrant industry of suppliers, developers, consultants, and trainers in the renewable energy sector, with 4 major solar companies compared to 2 at the start, and 15 developers compared to 2 at the start. Eighty electricity consumer associates existed compared to less than 10 at the start. Although the program started with dependence on Nepali technology, by its end Sri Lankan manufacturing had reached the point where they were exporting systems to overseas markets in Asia and Africa. DFCC Bank, the Administrative Unit (AU), was approached in December 2002 to distribute an additional 6,000 SHS outside of the project's scope. As one respondent proclaimed, "ESDP has had a lasting, positive mark on the renewable energy industry in Sri Lanka – it laid the entire foundation, caused a complete shift in the country's energy planning." And here's the kicker: it achieved all of these benefits *below cost*, budgeted for $55.2 million but spending only $44.5 million—savings that resulted from a combination of the creation of economies of scale, technological learning, and capacity building.

The next three subsections focus inductively on three of the most significant benefits from the solar component to the EFSD: accelerated household adoption, income generation, and the improvement of industry technical standards and training.

4.1 Accelerated diffusion of solar home systems

At the peak of the SHS subcomponent, after SEEDs became a PCI more than 1,300 systems were being sold each month, and four major vendors—Shell Solar, Access Solar, SELCO, and Alpha Thermal—established national networks. Only a few systems were sold *nationwide* in 1998, but almost 20,000 had been sold by 2001. Planners realized that as areas became "saturated" with SHS units vendors tended to close their shops and move to provinces where demand was "fresh," essentially leaving no dedicated maintenance support facilities.

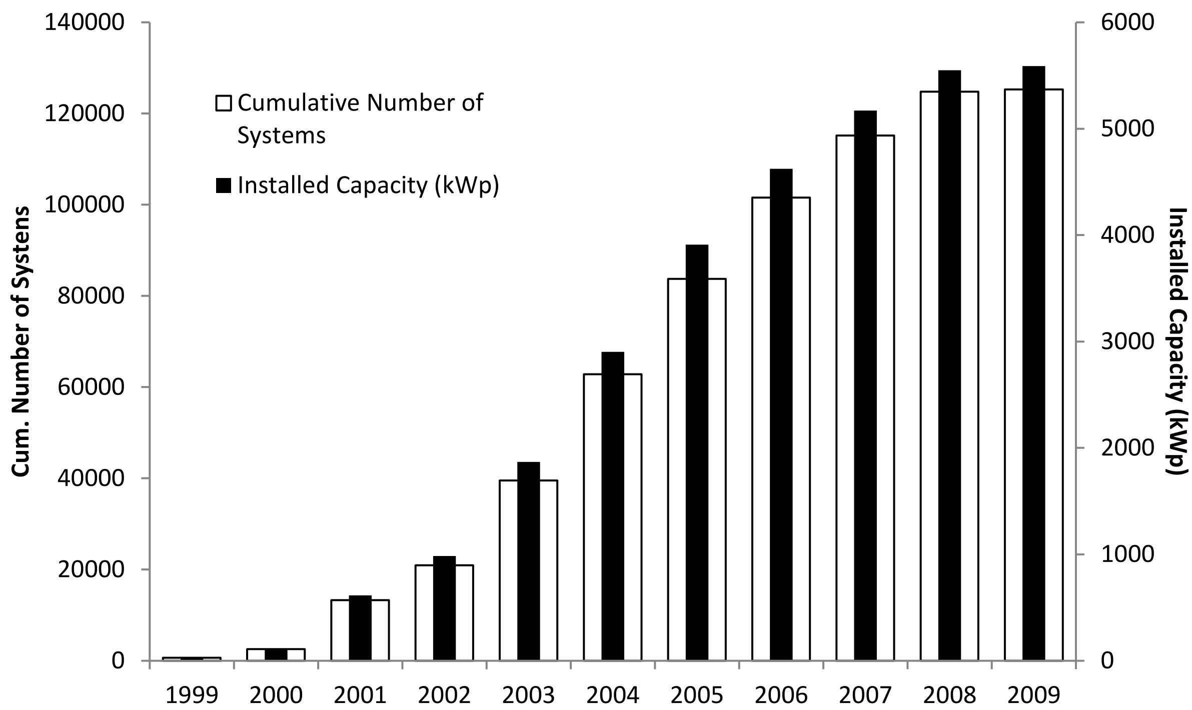
The ESDP therefore supported the creation of 80 permanent service and distribution centers with $5 million invested from the private sector. Over the duration of the ESDP, overall employment in the industry jumped from 50 to 1,500, and a Social Industry Association was established. As the owner of one major solar distributor noted, “Before the ESDP, we were selling 5 or 6 systems per month in town areas, not rural areas, and we had one branch office in Colombo; now, we’re installing 40 to 50 systems per month, mostly in rural areas throughout five branches.”

Table 4 shows that most of these systems ended up being 20 to 40Wp (32 percent) and 40 to 60 Wp (59 percent), and the subcomponent had a tiered subsidy which gave larger disbursements for smaller, less expensive systems. As Figure 2 shows, total installed capacity jumped from practically zero MWp in 1999 to almost 1 MWp in 2002 when the ESDP ended, growing to a staggering 5.5 MWp in 2008 (when sales started to plateau) with an annual turnover of $40 million. The program also saw the costs of SHS decline, from $11 per Wp in 1998 to slightly less than $10 per Wp in 2002.

Table 4: Details about the SHS Subcomponent of the ESDP

System Size	Percentage of Total Sales	ESDP Subsidy given to consumers		
		Year 1	Year 2	Year 3
10 to 20 Wp	2%	$40	$40	$40
20 to 40 Wp	32%	$70	$70	
40 to 60 Wp	59%	$70		
60 to 120 Wp	1%	$0		

Figure 2: SHS Sold and Installed Capacity Installed in Sri Lanka, 1999 to 2009



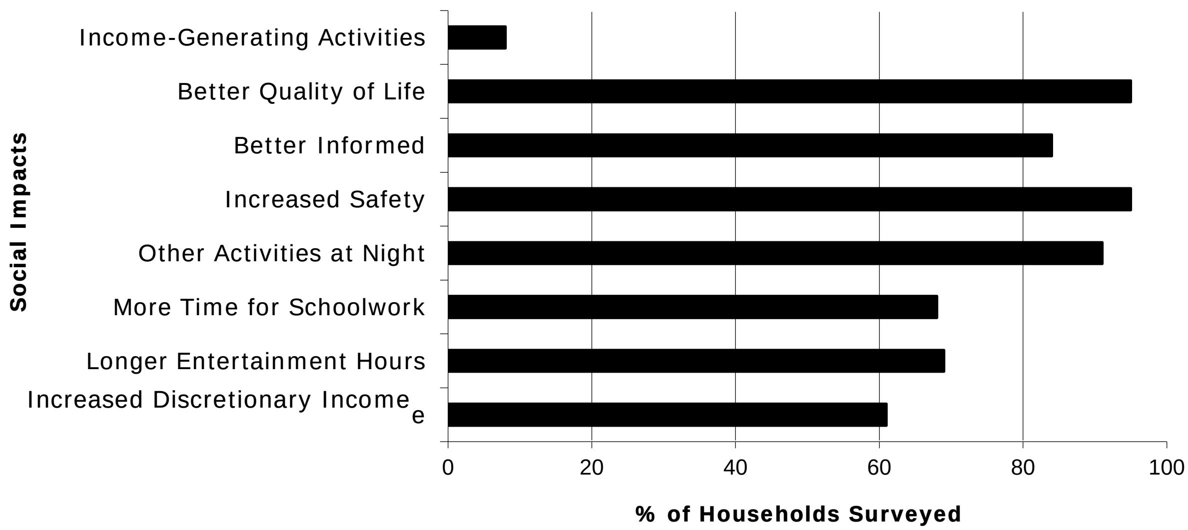
4.2 Community energy and income generation

Rising community incomes, and potent participation from local banks and villages in the ESDP, is also a testament to its success. Over the course of the project, PCIs contributed $16 million of their own funds, several nongovernmental organizations (NGOs) were operating in tandem with the ESDP project areas, and more than 30 villages were asking for solar or micro-hydro systems (World Bank 2003). As one bank manager told us, “we weren’t participating out of any sense of charity, we were driven by commercial viability.” Members of the AU also told the research team that “no major complaints” had ever arisen regarding the SHS and grid-connected components.

Indeed, an extensive survey done by the World Bank at the close of the project found that energy access through the ESDP promoted income generating activities, increased safety, longer studying, and a variety of other activities shown in Figure 3. SHS units, for example, cost only

$750 over ten years at that time, including battery replacement, but many rural homes spend $650 per year on kerosene and automotive batteries—meaning units paid for themselves quite quickly.

Figure 3: Social Impacts of ESDP Project on Rural Households



Source: Research interviews.

Many of these benefits were confirmed by an independent, follow-up study by the United Nations Development Program (2012). That study found that SHS reduced kerosene consumption even more from 11 liters to 0.7 liters, and eliminated expenditures on charging batteries in 93 percent of households. Moreover, 50 to 90 percent of households surveyed stated that access to electricity from SHS provided better lighting, led to longer studying hours, a greater sense of safety and security, and facilitated the introduction of televisions. electric irons, radios and mobile phones.

4.3 Industrial technical standards and effective sales techniques

Though perhaps more difficult to measure than the other components, the ESDP strengthened capacity in a variety of ways. For the SHS subcomponent, the ESDP supported the design and enforcement of technical specifications for SHS and also trained technicians to conduct spot checks, develop after sales service models, and provide customers a way to lodge complaints.

Part of what drove such high sales and satisfaction levels were new sales techniques developed and perfected with technical assistance from the ESDP. One was displaying products to large groups of people rather than individuals; vendors and PCIs sent speakers with units to garment factories, schools, and hospitals, giving demonstrations and/or answering questions during lunch breaks or between shifts. Another was innovative displays: as one respondent put it, "our rural salespeople went and fixed SHS in temples, churches, and community centers so people could literally see what they could do." Another was door to door visits for SHS done at night, so people could see firsthand what rechargeable torches and electric lights can offer them. A fourth was dealers traveling by motorbike to loan sample systems for a single night so households could become familiar with solar electricity. A fifth was targeting women as beneficiaries since household surveys revealed that electricity access benefitted them the most—as it enabled labor saving appliances, reduced household chores, provided access to entertainment, and positively impacted family routines. A sixth was sending along bank officers with the technicians doing demonstrations so interested community members could sign up on the spot.

5. The political economy of solar failure: Sri Lanka

The ISHSP seemed ready to promote SHSs at the same scale and scope of the ESDP, through the implementation of its credit and implementation support components, as well as through its assistance to the solar PV industry. However, soon after the project became effective in October 1997, it became clear that its design needed a major overhaul owing to the rapidly deteriorating economic and political situation in Indonesia following the Asian Financial Crisis. The devaluation of the Indonesian Rupiah (IDR) against the United States Dollar had resulted in a severe credit crunch in the banking sector, "the worst since the 1970s," according to one respondent. Two of the four PBs closed down; whereas the other two were barred by Bank Indonesia from offering credit until 2000 (World Bank 2004). Concomitantly, the high import content of SHS units had increased their price more than three-fold, hampering the ability of both dealers and potential customers to sell or buy SHS units.

Starting from 1998, significant changes were made including revising sales targets from 200,000 to 70,000 SHS units; reducing the standard size of the SHS units sold from 50 Wp to a minimum of 10 Wp; adjusting the GEF grant to a $2 per Wp subsidy instead of a per system subsidy; closing the IBRD loan due to lack of demand for credit; and canceling the "Decentralized Rural Electrification Study and SHS Implementation Plan" (World Bank 2004).

Unfortunately, these measures proved ineffective. The World Bank (2004: 15) admitted that the project became plagued by "slow progress of the SHS sales, weak investment in rural distribution networks, and inability of the banks to make loans to SHS dealers." Our interviews with key stakeholders reflecting on the project years onwards suggest that the reasons for project failure may have been more fundamental, and that perhaps the financial crisis became an excuse rather than a major impetus.

Indeed, in this section, we inductively draw from the data to summarize three core factors behind the program's failure: high capital costs, a poorly designed credit vehicle, and inadequate dealer support.

5.1 High capital costs in a time of crisis

Lacking a workable credit facility to make systems more affordable and a proper supply chain to reduce transaction costs, the development of the solar PV market was further impeded by several factors that the project design was not able to rectify. Certainly, the financial crisis affected the purchasing power of many potential customers that saw slumps in the value of their cash crops. Most damaging, however, was that the project had to bear foreign exchange costs of imported SHS components amounting to approximately $85 million equivalent, or more than 70 percent of project costs (World Bank 1996). Solar panels, the most expensive component, were imported from Japan, Korea, and Germany. Some SHS parts such as charge controllers, batteries, and energy-efficient bulbs were already being produced domestically at the time, yet contained a significant amount of imported parts and materials.

Unsurprisingly, dealers used the opportunity of the financial crisis to venture into foreign solar PV markets and benefit from the much stronger US Dollar. The Implementation Completion Report cites the success of certain dealers in exporting balance of system components to Sri Lanka as part of the World Bank's ESDP as well as for commercial sales in Kenya (World Bank 2004).

Respondents felt that instead of subsidizing foreign PV markets, the project could have invested some of this funding into developing the domestic solar PV assembling and manufacturing industry, which would have gradually brought down dependence on imports and consequent high SHS costs. Although the BPPT did make some inroads in this direction, the industry is still underdeveloped today, very much dependent on imported content, and so far unable to reap the benefits of economies of scale, despite the fact that the country has recovered remarkably from the financial crisis.

5.2 Mismatched credit vehicle and a weak banking sector

The project's credit component was ill equipped from the beginning to help the fledging solar PV industry overcome first cost hurdles. This was mainly due to a poorly conceived credit facility that failed to provide the suitable financial infrastructure and banking products for a rural clientele, and to support struggling SHS dealers.

At the start of the project, Indonesia's solar PV market was what the World Bank characterized as in a "high price low volume" equilibrium (World Bank 2004). As SHSs are self-contained generation and distribution systems, the initial capital cost is very high in proportion to the total operating and maintenance costs over the lifecycle – in many cases, representing almost one year of income in low- and middle-income rural households (Cabraal et al. 1997). Moreover, under Indonesian banking practices, commercial banks were only allowed to offer credit over a period of one or two years, which is hardly an affordable period of cost amortization for such households. Despite the various measures that had been put into place under the project, the World Bank (2004: 21) noted "a lack of established high-volume supplier-dealer chains, high prices, and a lack of term credit" continued to hamper market development.

As mentioned above, a $20 million equivalent IBRD loan was channeled through Bank Indonesia to four PBs to provide SHS dealers with access to capital investment and to allow them to offer credit lines to prospective customers. Due to repercussions of the Asian Financial Crisis, however, two of the selected PBs were not able to participate due to their dire financial situation; whereas the other two remained wary of Bank Indonesia's increasingly strict regulations on non-performing loans (NPLs) even after their recapitalization was completed in the middle of 2000. In the end, only one PB was prepared to offer any credit, and despite keen interest from SHS dealers, only $0.1 million of the $20 million loan was utilized before the World Bank (2004) decided to close it down at the end of 2000, fifteen months ahead of schedule. Subsequently, five out of the six dealers that had committed to the project went out of business, with reports of NPLs overpopulating the market.

Our interview data suggests that the design of the credit facility focused too much on mobilizing SHS dealers and too little on aligning to the priorities and concerns of PBs and building their capacity as the managers of the funds. Apart from the financial crisis, the risk-averseness of the PBs was also due to their lack of familiarity with the rural market in general and solar PV technology in particular. Serving rural customers with limited income and assets would have required experience in rural banking products such as microfinance, as well as a strong presence on the ground, the collective domain of the thousands of government cooperatives and microfinance institutions, one of which is pictured in Figure 4. In addition, PBs would have to experiment with a business model they did not understand. “Renewable energy projects are very risky compared to coal projects,” claimed one respondent, “We do not have the requisite knowledge to finance them.” Another admitted, “We would not know what to do with reacquired SHSs in the case of defaulting customers, unlike with motorcycles,” referring to the popularity of credit lines for motorcycles.

Figure 4: A Small Cooperative on Lake Cirata, West Java, Indonesia

At the same time, it appears that potential customers, at least in some target communities, did not properly understand the supposed benefits of the credit facility. Among the SHS users we interviewed, some had made use of the available credit to pay for their systems, but an equal number of respondents had paid cash, as they were unfamiliar with the banking practices in general. These respondents generally represented households that were in the upper-income bracket of the rural population. With more disposable income, they typically had larger SHS units and used the electricity for some productive uses such as lighting fishponds or small convenience shops. They were also often former owners of diesel-powered generators, glad to be using more economical systems.

However, we also encountered those respondents from lower-income households that had little or no source of lighting prior to their SHS units and had benefitted from either free government-funded SHS programs and/or the cheaper second hand SHS market rather than from participating directly in the project. One of these respondents commented that had it not been for the free SHS, he would have not minded to continue living in darkness. When combined with what PBs viewed as excessive bureaucratic borrowing requirements imposed by the World Bank, it is understandable why PBs considered the project "doable, but not bankable" and therefore impractical to warrant robust involvement.

Instead, the project placed the burden of SHS commercialization almost entirely on inexperienced SHS dealers through its dealer-sales model. The project's credit component as it stood made dealers and customers responsible for financing $66.8 million equivalent or almost 60 percent of project costs, mainly through the payment of monthly installments. It seemingly distributed the investment risks of the credit facility among the different stakeholders involved, with the PBs bearing the dealer credit risk and the dealer bearing the consumer credit risk. However, because it was the dealers rather than the PBs, the WBG, or the government that were responsible for complex and arduous task of administering the loans to customers and monitoring compliance, it was also ultimately the dealers left with shouldering the financial risk of loan defaults. "It would have been far preferable for us that banks be in charge of the loans," mentioned one respondent. "When banks are responsible for collecting payments, companies can focus on providing the SHS and related services."

5.3 Inadequate dealer capacity

As PBs lacked the rural networks to deal directly with customers, a dealer-sales model was employed, whereby six Jakarta-based dealers were tasked to establish rural outlets and would take responsibility for the procurement, sales, installation and maintenance of SHS units; and for offering term credit to make the systems more affordable to prospective customers. The eligibility criteria for dealers included proven business competence, the existence of sales or services infrastructure in the targeted markets, and a credit agreement with a PB (Martinot et al. 2001).

However, our data revealed that SHS dealers were mainly small and inexperienced enterprises in a nascent market, peddling an unfamiliar product and novel concept of electricity services. Deprived of their main source of investment capital from the very beginning due to the reluctance of PBs to offer credit, dealers were further constrained in their ability to finance and develop their businesses as the price of SHSs jumped three-fold following the drastic depreciation of Indonesian currency. This was especially true after the IBRD loan was terminated and dealers only had the option of using their own financing to continue their businesses. "Without credit from the banks, we had to provide financing from our own pockets," explained one respondent "This was very tough for small businesses like ours." Even when sales targets were reduced from 200,000 to 70,000 units in 2001, dealers were still not able maintain sufficient inventories and establish the necessary rural outlets. As described by another respondent, "I had to cover three whole regencies with only one motorbike. It was an impossible job."

Rather than being allowed to focus on building a proper SHS supply chain and a rural service infrastructure, dealers also had to build their rural credit delivery and collection infrastructure – both requiring very different sets of skills and expertise. In this context, respondents felt strongly that "the magnitude of the installation targets was not comparable with the efforts to build capacity." Apart from a few workshops that were limited to sending only a few staff at a time, there was very little support for dealers to upgrade their skills and expertise, develop their businesses, approach banks for financing, learn about rural credit, and address problems on the ground. The grants provided by GEF did little to improve their "unsatisfactory" performance as the project required that dealers offer credit to their customers as a condition of eligibility to receive these grants. This caused problems for dealers who did not feel secure enough to borrow or extend credit. Moreover, as a respondent lamented, "A $100 for every SHS sold is not enough. They should have increased the grant amount after the crisis."

6. Discussion: Five Broader Lessons for Energy Access Programs

Apart from offering a stark tale of contrasts, the ESDP and ISHSP offer five broader lessons for energy and development practitioners and researchers. .

6.1 Polycentric involvement of financial institutions

The ESDP had a highly participatory project design involving the national utility, private developers, and local groups, and institutionalized stakeholder engagement with quarterly meetings and ad hoc consultations. It reveals the usefulness of including a broad set of stakeholders in program implementation—from the communities themselves and NGOs to the commercial and public sectors. The ESDP mobilized communities at the grassroots level, working with villagers, councils, provincial officials, and Electricity Consumer Societies. This ensured project ownership on the part of communities and strengthened community capacity to effectively manage SHS, and it involved the financial and microfinance sector. Unlike Indonesia, it selected strong PCIs with national networks, including commercial banks giving wholesale loans to firms as well as microfinance organizations, like SEEDs, to provide small-scale household loans "where ordinary banks cannot." It also awarded grants and capacity building efforts to local manufacturers and distributors. As one respondent put it, "The ESDP was private sector oriented, not government sector oriented; if it was a government sponsored thing, it would not have worked as well, my guess is half the money would have gone into the pockets of politicians." The ESDP in Sri Lanka had a strong AU behind it plus a collection of banks and trade and industry associations. These included the Solar Industries Association and a Federation of Electricity Consumer Societies in addition to a dedicated NGO (Practical Action) and impassioned microfinance institution (SEEDS). As one respondent explained, "one of the reasons the ESD succeeded is because the government stayed out—the private sector just ran with it, guided by the AU." Essentially, this involvement of diverse and heterogeneous actors ensured that "multiple layers of auditing and accountability" were created to sustain the project.

In Indonesia, by contrast, the four PBs that had been selected were still unfamiliar with investments in the renewable energy sector and none of the six appointed SHS dealers had developed an effective supply chain and financial mechanism to deploy SHSs on the scale intended by the project. The solar PV market was still very much in its infancy and the project therefore needed greater government involvement to guarantee appropriate the institutional and regulatory environment. Moreover, the ISHSP saw SHS vendors generally overwhelmed from having to provide credit lines to potential customers and collect installments to pay enough attention to after-sales services. As a consequence, Indonesian customers had to be responsible for their own maintenance and servicing. The credit component of the Indonesia SHS Project failed to adjust to the economic realities of the Asian Financial Crisis. With little domestic manufacturing and assembly, the program was entirely dependent on foreign components, which meant the regional crisis saw the devaluation of Indonesian currency and a threefold increase in the costs of SHS systems.

The credit component of the Indonesia SHS project was designed to overcome the first cost barrier found to be critical in the uptake of capital-intensive technologies such as SHSs in rural areas (Miller and Hope 2000). However, no stakeholder was willing to fully shoulder the investment risks of an unchartered rural market for solar PV technology. What was needed was a responsive financial infrastructure that provided several mechanisms to reduce the risk of investing in a new market and that allowed for greater flexibility to adapt business models to changing market signals. The Indonesia SHS Project did none of these things.

Additionally, dealers decided to export systems out of Indonesia to take advantage of the strong US dollar, meaning the program in essence subsidized overseas investment rather than the domestic expansion of energy access. The BPPT as the principle implementing agency did very little to adjust the project design to properly involve financial institutions, SHS vendors, and end-users in the project – mainly letting the Asian Financial Crisis take its toll. As a result, at the end of the project, two out of the four participating banks had gone bust, only one out of the six approved SHS dealers remained in business, and only a disappointing 8,054 out of 200,000 sales were achieved.

6.2 Flexibility in technological scope and geographic coverage

The ESDP demonstrates the viability of flexibility in at least three senses. One is a strategic flexibility involving where to extend the national grid, where to push for village hydro-powered microgrids, and where to deploy isolated SHS units. The ESDP promoted all three types of technologies—grid-connected, mini-grid, and off-grid—but only in particular areas, and never in the same place. Another is that it had flexible business and financial models matched in scale to each of these three technologies. For SHS units, the ESDP mostly supported solar dealers who formed credit partnerships with banks and microfinance institutions. No “one size fits all approach" was employed; instead the ESDP was "very targeted" and "differentiated." A third is the flexibility inherent in modifying and revising the program itself in the face of feedback and challenges. When it became apparent that the SHS subcomponent was not meeting its targets, the scheme was revised and SEEDs brought in as a PCI. Managers of the ESDP, as one respondent put it, "quickly and effectively responded to issues raised by stakeholders." Another noted that the "beauty of the project is that it had the flexibility to acknowledge failures and change the rules, operating guidelines were inherently flexible and adaptable."

In Indonesia, planners pushed solar energy because expert consultants told them to, not because communities had expressed an organic demand for the technology. It appears llittle effort was made to fully understand the true energy needs of the targeted population or to involve them in the project design. According to respondents, there was never a study sufficiently done to assess whether the technology has been understood and accepted by the wider Indonesian population. In fact, many questioned the choice of SHSs in the first place, perceived by some as an unfamiliar technology "imposed on Indonesia" from the World Bank rather than a "need stemming from an expressed interest of the rural population." Doubts were raised whether the technology was even suitable for sufficient solar irradiation considering frequent cloud cover, high levels of humidity in the tropics, and the fact that many of the remote areas targeted are in dense forest areas. In this regard, it was suggested that perhaps concentrated solar power or other renewable energy sources such as geothermal, hydro, or biogas could have been more appropriate solutions for rural electrification.

Also, only one type of SHS was eligible, unlike the flexibility enshrined in the ESDP. The dismal sales of SHS units were not simply a reflection of reduced purchasing power of end-users and retailers due to the Asian Financial Crisis. Many end-users did not place enough importance on electrification. Moreover, competing government initiatives deploying SHS through grant mechanisms severely hampered the market-based approach of the program. While end-users did not mind using SHS units, they naturally preferred waiting for government subsidies or buying from the cheaper second-hand market. In this regard, the selection of provinces was based on a presumed rather than expressed need from the communities targeted. While the program did successfully develop technical specifications, testing, and certification, the inexperienced and disinterested BPPT was not able to translate these gains into opportunities for other stakeholders, especially fledging local SHS companies.

The provinces chosen for potential target markets were also in question considering not many dealers had networks in Lampung and South Sulawesi at the beginning of the project. As a result, most were functionally excluded from taking part. Some respondents were of the opinion that the selection of the target areas was too ambitious, whereas others thought that the project could have included more provinces and did not do enough to leverage on the natural strongholds of many other competent SHS dealers.

6.3 Political harmonization and support

The ESDP affirms the salience of political harmonization in two ways: strong leadership from project champions, and alignment with other national policies and frameworks. In terms of leadership, the ESDP thrived under a “strong,” “dedicated,” and “fiercely independent” AU, DFCC Bank, willing to “initially sustain losses from operations for the first three years.” As one respondent explained, “one of the reasons the ESDP succeeded is because the government stayed out—the private sector just ran with it, guided by the AU.” In terms of regulatory alignment, when the ESDP began, only the national utility CEB could generate power and off-grid generators were “technically illegal”. Planners had to implement the entire “community and village concept" and "IPP concept" from the "ground up," changes which apparently even involved altering the Sri Lankan constitution. The ESDP also worked closely with national planners and CEB officials to set tariffs, enact legislation, create a Sustainable Energy Authority, and an Energy Forum—culminating in what one respondent called "an extremely supportive policy environment."

Indonesia demonstrates the opposite. Government subsidies and price incentives gave the "wrong" signals, with other ongoing programs giving away solar panels for free and the government increasing subsidies for kerosene. The national government expanded the grid to communities that had just purchased SHS units, flooding the secondary market and mitigating the desire for households to pay for systems. Most respondents we interviewed criticized the continued prevalence of free SHSs provided through government-funded programs in parallel to the project. Some villagers we talked to in Lampung mentioned that they had preferred to wait for these free SHSs, even though stocks were limited and the waiting lists were long, rather than purchase their own units. Other villagers had continued to use kerosene lamps, benefiting from highly politicized government subsidies that were only stopped in 2000.

A lack of coordination with PLN (the national state owned electric utility) was another problem as former customers living in target areas that were eventually abandoned by dealers due to the availability of grid electricity flooded the market with cheaper and less-regulated second-hand SHSs. Many villagers we interviewed during our field visits admitted that they had gotten their systems from this second-hand market. These respondents stated that they preferred to receive "inferior goods" rather than pay the premium for a new system. Considering the well-known fact of inadequate after-sales services – which at some point became practically non-existent after all but one dealer remained in business during the project – it was perhaps not a poor choice to make.

6.4 Capacity building and awareness

The ESDP built capacity through grants, technical assistance, and outreach in a variety of ways, many of which proved to be very effective. It facilitated feasibility and pre-investment studies of household energy use as well as renewable resource potential. It did initial market surveys to ask communities what they wanted, and to determine their willingness to pay (if any) for electricity. These studies improved local capabilities and the understanding of markets, strengthened community knowledge of resources, and aided in cost recovery. They, in the words of one respondent, ensured that “market principles, based on sound economic data, determined the proper course of action for each community.” The ESDP improved the capacity of PCIs so that their turnaround time for loans dropped from more than three months to less than one month. It implemented technical standards to improve the quality of Sri Lankan technology and ultimately protect consumers. These preempted common problems related to over-usage, misusage, maintenance and repairs were less common and more easily addressed when they did occur. These standards also “ensured the quality, safety, and longevity” of the equipment involved in the ESDP. The ESDP supported the construction of 80 service centers for solar equipment so that the maintenance needs of rural households were always cared for. Finally, it implemented a string of awareness raising activities so that educated consumers could make informed purchase decisions—whether it was an small independent power manager contemplating a micro-hydro project, a village leader thinking about off-grid hydro, or a household considering a SHS. These included demonstrations, advertising campaigns, workshops, and seminars.

The ESDP awareness campaign in particular targeted provincial officials and village decision makers and trained them in basic renewable energy concepts, financial options, and feasibility studies; once they were ready to consider systems, it facilitated workshops on appropriate designs. It also sponsored classes at the National Engineering and Research Institute and local technical colleges. It promoted a national advertising campaign entitled *Gamata Light* run by the Sri Lanka Business Development Centre which featured newspaper ads, television ads, and radio broadcasts promoting SHS. One of them is shown in Figure 5. These awareness efforts were not "one way." The ESDP also sought feedback from households, village energy committees, and operators themselves through formal surveys and informal workshops. Based on this feedback, planners learned that common problems facing the SHS subcomponent were improper battery charging, wiring defects, loose connections, and incorrect mounting of the solar panel.

Figure 5: Part of the *Gamata Light* Campaign Showing the Value of ESDP-affiliated Electricity

In Indonesia, however, capacity building was underutilized. The program spent 95 percent of its budget on technology and only five percent on capacity building. Due to limited funds, dealers were not able to afford television or radio commercials or even brochures. Thus, in order to reach as many people as possible, usually a technician would make a presentation in each village community center, followed by a technical demonstration. “It was always a very formal affair,” explained one respondent. “It was very important to ensure that the village chief is present in this presentation, to give him respect. If you are able to convince him regarding the importance of the SHS and the legitimacy of your business, it is easier to approach and educate other villagers." These marketing campaigns, scarce and homegrown as they were, were all too infrequent.

6.5 Programmatic self-sufficiency

Lastly, and critically, the ESDP cultivated a self-sustaining market for SHS (that no longer needed the program to thrive, at least until massive investments in grid electrification occurred after the end of the project) whereas the ISHSP was all too dependent on government largesse.

The ESDP cultivated commercial viability by ensuring that technologies were not "given away" and by sharing costs among its stakeholders. It forcefully demonstrates that households are willing to pay more than they usually do for energy expenditures as long as their supply is reliable and safe. It altered the energy development approach of the government from a "dole out" mentality to one based on "sustainable markets," one requiring that communities participate themselves in hydro and solar projects by offering not only their cash but also labor and materials; and one demanding higher than usual returns on investment, always in the double digit range. This focus on commercial viability did three things: it created a sense of community ownership, it meant end-users no longer viewed energy services as a "charity" or "free entitlement," and it largely resulted in a market for renewable energy that could sustain itself after the ESDP ended.

In Indonesia, by comparison, BPPT's success in testing and certification of SHSs did not translate into better capacity building opportunities for other stakeholders. "BPPT was in a very privileged position. As the focal point of the project, it benefited from all capacity building efforts. But it did not encourage other elements of the market to grow," criticized one respondent. The premature closing of the IBRD loan, which resulted in all but one dealer going out of business, also indicates that dealers were not successful in developing the capacity to enter the market without project support let alone being able to independently catalyze commercial demand for solar PV technology. “There was a large vacuum in the solar PV market until 2005,” described another respondent.

7. Conclusion

In sum, the success of Sri Lanka’s ESDP contrasted with the failure of Indonesia’s ISHSP reminds us forcefully that a similar market-based approach to energy access and solar electrification—in this case, one adopted by the World Bank—can produce drastically different effects. How?

Sri Lanka’s ESDP exhibits the strength of having a well-designed financial model and credit facility, a dedicated implementing agency, and stakeholder participation and capacity building. The ESDP allowed end-users to take charge of their electricity needs in the absence of government provision, reaching villages which would have otherwise not have received electricity services. It improved the financial status of many rural villages and resulted in productive activities such as sewing and carpentry; and also substantially lessened consumption of kerosene, producing public health benefits. It benefited from cost-sharing among development donors, financial institutions, vendors, and end-users – tailoring financial requirements for different stakeholders and project components. In other words, a demand-driven approach was adopted to design multiple financial models to suit multiple stakeholder needs rather than purely “free money.”

The ISHSP in Indonesia failed to overcome first cost barriers, secure sufficient government involvement, and engender long-term sustainability. It suffered from an improperly designed financial model that calculated risks and incentives poorly, limited capacity building for local stakeholders, and minimal effort to inquire about what Indonesian end-users desired or needed –

as they were merely seen as passive energy consumers. The Indonesian government was almost totally uncoordinated in the implementation of the project. Private sector players and financial institutions lacked knowledge about solar energy and were risk averse, and many users remained uninformed about SHS or uninterested in electricity altogether. In essence, the Indonesia SHS Project failed because it did not adapt or adjust to local circumstances and needs.

The confluence of success and failure—effective versus flawed financing vehicles, adequate versus poorly structured SHS supply chains, and harmonized versus fragmented government policy—remind us that promoting energy access and responding to energy poverty are highly contextual. It means one must unpack what is meant by "market based" as well—what *types* of markets, structured under what *governance* conditions, subject to which *management* pressures, based on which *technologies*? Thus, the efficacy of market based solutions for solar electrification are dependent on a mix of circumstance, technological learning, policy efficacy, program leadership, capacity building, and user awareness. Even a highly influential actor such as the World Bank sees its agency and efficacy atrophied in the face of such contextual specificities. Without the proper alignment of economic, technical, and political factors, even those projects with the best intentions can quickly fail to achieve their goals.

8. Acknowledgments

Both Ira Martina Drupady and Martin Stagenhaven have the author's thanks for their assistance with conducting some of the field research for this paper. The author is also extremely grateful to the National University of Singapore for Faculty Start-up Grant 09-273 as well as the MacArthur Foundation for Asia Security Initiative Grant 08-92777-000-GSS, which have supported elements of the work reported here. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the Centre on Asia and Globalisation, Lee Kuan Yew School of Public Policy, National University of Singapore, or MacArthur Foundation.

9. Abbreviations and Acronyms

$ - Denotes United States dollar unless otherwise indicated

AU – Administrative Unit

BPPT - Agency for the Development and Implementation of Technology (in Indonesia)

CEB – Ceylon Electricity Board

DFCC - Development Finance Corporation of Ceylon (in Sri Lanka)

ESDP - Energy Services Delivery Project (in Sri Lanka)

GDP – gross domestic product

GEF – Global Environment Facility

GWh - Gigawatt-hour

IBRD - International Bank for Reconstruction and Development

ISHSP - Indonesia Solar Home System Project

kW - kilowatt

LIPI - Indonesian Institute of Sciences

LOLC - Lankia Orix Leasing Company (in Sri Lanka)

MEMR - Ministry of Energy and Mineral Resources (in Indonesia)

MENRISTEK - Ministry of Research and Technology (in Indonesia)

MW - megawatt

MWp – megawatt-peak

NGO – nongovernmental organization

NPL – non-performing loan

PB - participating bank

PCI – Participating Credit Institution

PLN - Perusahaan Listrik Negara

PV = photovoltaic

SEEDS - Sarvodaya Economic Enterprises Development Service

SHS – Solar Home System

SHSs – Solar Home Systems

SPPA - small power purchase agreements

WBG – World Bank Group

Wp - Watt-peak

10. References

Cabraal, A. et. al. 1997. *Accelerating Sustainable PV Market Development,* The World Bank.

Caron, Cynthia M. 2002. Examining Alternatives: The Energy Services Delivery Project in Sri Lanka. Energy for Sustainable Development 61 March, pp. 38-46.

Chaurey, A, Krithika PR, Palit D, Rakesh S, and BK Sovacool. "New Partnerships and Business Models for Facilitating Energy Access," Energy Policy 47(1) (June, 2012), pp. 48-55.

Clark, Dana L. *A Citizen's Guide to the World Bank Inspection Panel* (Washington, DC: Center for International Environmental Law, October, 1999)

Gollwitzer, Lorenz, David Ockwell, Ben Muok, Adrian Ely, Helene Ahlborg, Rethinking the sustainability and institutional governance of electricity access and mini-grids: Electricity as a common pool resource, Energy Research & Social Science, Volume 39, 2018, Pages 152-161.

Halff, Antoine, J Rozhon and BK Sovacool (Eds.). Energy Poverty: Global Challenges and Local Solutions (Oxford: Oxford University Press, 2014)

Integrated Development Association. 2004. Energy for Sustainable Development Sri Lanka – A Brief Report with Focus on Renewable Energy and Poverty Reduction. Kundasala, Sri Lanka: International Network for Sustainable Energy.

International Energy Agency. 2017. WEO-2017 Special Report: Energy Access Outlook (Paris: OECD).

International Energy Agency. 2018. Energy Access. June 1. (Paris: OECD). Available at https://www.iea.org/energyaccess/.

Kapadia, Kamal. 2003. *The Not-So-Sunny Side of Solar Energy Markets: A Case Study of Sri Lanka* (Berkeley: Energy and Resources Group at the University of California Berkeley, Master's Project, May 20).

Keohane, Robert . Intergovernmental Organizations and Garbage Can Theory, *JPART* 12(2) (2002): 155-159

Martinot, E., Cabraal A., and Mathur, S. 2001. World Bank/GEF Solar Home System Projects: Experiences and Lessons Learned 1993-2000. *Renewable and Sustainable Energy Reviews 5*(2001).

Miller, D. and Hope, C. 2000. Learning to Lend for Off-grid Solar Power: Policy Lessons from World Bank Loans to India, Indonesia, and Sri Lanka. *Energy Policy* 28 (2000), Elsevier Science Ltd.

Nagendran, Jayantha. 2001. Sri Lanka Energy Services Delivery Project Credit Program: A Case Study Colombo: DFCC Bank, May.

Nagendran, Jayantha and Vijay Iyer. 2001. Energy Services for Villages: Sri Lanka Energy Services Delivery Project Credit Program Colombo: Sri Lanka Business Development Centre, April.

Ockwell, D., R. Byrne, Sustainable Energy for All: Innovation, Technology and Pro-Poor Green Transformations. London. Routledge (2017)

Ockwell, D et al. The uptake and diffusion of solar power in Africa: Socio-cultural and political insights on a rapidly emerging socio-technical transition. Energy Research & Social Science 44 (2018) 122–129

Retnanestri, M. 2007. *The I3A Framework: Enhancing the Sustainability of Off-Grid Photovoltaic Energy Service Delivery in Indonesia.* Sydney: University of New South Wales.

[SEforALL] Sustainable Energy for All. Strategic Framework for Results 2016-21 (Washington, DC: June 2016), http://www.se4all.org/sites/default/files/2016_EUSEW_LR.pdf.

Sovacool, BK and IM Drupady. Energy Access, Poverty, and Development: The Governance of Small-Scale Renewable Energy in Developing Asia (New York: Ashgate Studies in Environmental Policy and Practice, 2012)

Sovacool, BK. 2013a. “Expanding Renewable Energy Access with Pro-Poor Public Private Partnerships in the Developing World,” Energy Strategy Reviews 1(3) (March, 2013), pp. 181-192

Sovacool, BK. 2013b. “Expanding Rural Access to Renewable Energy: Lessons from Sri Lanka’s Energy Services Delivery Project (ESDP),” Journal of Resources, Energy, and Development 10 (2) (September, 2013), pp. 79-104.

Sovacool, BK. “Monitoring the Moneylenders: Institutional Accountability and Environmental Governance at the World Bank’s Inspection Panel,” Extractive Industries & Society 4(4) (November, 2017), pp. 893-903.

Sri Lanka Sustainable Energy Authority. 2009. Sri Lanka Energy Balance 2007: An Analysis of Energy Sector Performance Colombo: SEA.

Ulsrud, Kirsten Tanja Winther, Debajit Palit, Harald Rohracher, Village-level solar power in Africa: Accelerating access to electricity services through a socio-technical design in Kenya, Energy Research & Social Science, Volume 5, January 2015, Pages 34-41

Ulsrud, Kirsten, Harald Rohracher, Tanja Winther, Charles Muchunku, Debajit Palit, Pathways to electricity for all: What makes village-scale solar power successful?, Energy Research & Social Science, Volume 44, 2018, Pages 32-40

United Nations Development Program, Renewable Energy Sector Development: A Decade of Promoting Renewable Energy Technologies in Sri Lanka Bangkok: UNDP Regional Center, January, 2012

Venkateswaran, Jayendran, Chetan Singh Solanki, Kelsey Werner, Gautam N. Yadama, Addressing Energy Poverty in India: A systems perspective on the role of localization, affordability, and saturation in implementing solar technologies, Energy Research & Social Science, Volume 40, 2018, Pages 205-210.

World Bank 1996. Republic of Indonesia Solar Home Systems Project. *Project Document.* Washington: The World Bank.

World Bank. 2003. Implementation Completion Report for an Energy Services Delivery Project. Washington, DC: World Bank, June 4, Report No. 25907, pp. 25-26.

World Bank 2004. Solar Home Systems. *Implementation Completion Report.* The World Bank, East Asian and Pacific Region.

World Bank 2011. Interregional Resource Transfer and Economic Growth in Indonesia, Volume 1. *Poverty and Inequality.*

World Bank, *Annual Report 2015* (Washington, DC: World Bank Group).